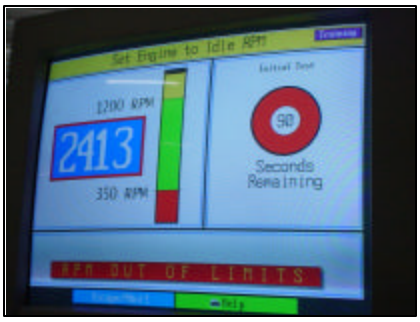


ASM OBDII TSI

Emissions Inspector Study Guide

AirCheckTexas

Produced by the Texas Department of Public Safety

VIE-28 (5/05)

Texans - Doing our share for cleaner air!

Select an area of instruction to begin the ASM, OBDII, and TSI training course.

History of I/M | ASM Training | OBDII Training | TSI Training

Back to Training Menu

Texans - Doing our share for cleaner air!

History of the I/M Program

History of I/M Program

Texas emissions testing began in 1990 and has evolved into the current various programs now in use. These programs include Acceleration Simulation Mode (ASM), On-Board Diagnostics (OBD), and Two-Speed Idle (TSI).

Applicability: Affected County/Designated Vehicle

Affected County

- § Any county participating in an inspection and maintenance program (I/M) to reduce harmful emissions from motor vehicles.

- **Designated Vehicle**
  - § Any vehicle capable of being powered by gasoline,
  - § Two through twenty-four years of age,
  - § Required to be registered in an "affected" county,
  - § Primarily operated in an affected county.

Applicability

§ **Exempt Vehicles**
- § Vehicles not capable of being powered by gasoline,
- § Vehicles not required to be registered in an affected county or not primarily operated in an affected county,
- § Vehicles who qualify or whose owners qualify for certain waivers or time extensions,
- § Motorcycles,
- § Certain slow moving vehicles.

Waivers and Extensions

Low Mileage Waiver
Individual Vehicle Waiver
Low-Income Time Extension
Parts Availability Time Extension

Advise customers to contact the local Texas Department of Public Safety Vehicle Inspection Waiver office for further information on waivers and extensions or www.aircheckTexas.com.

EmissionsOverview

Inspection/Testing Fees

Refer to the following fee charts for your "affected county".

Dallas/Ft. Worth and Houston/Galveston Areas

El Paso County

Travis and Williamson Counties

Texas Department of Public Safety

TEXAS DEPARTMENT OF PUBLIC SAFETY
AIRCHECKTEXAS EMISSIONS PROGRAM

NOTICE TO MOTORISTS

INSPECTION FEES IN THE DALLAS/FT. WORTH AND HOUSTON/GALVESTON AREAS

Effective 5-1-2002

GASOLINE POWERED MOTOR VEHICLES 2-24 YEARS OLD	(up to) $39.50
NEW PASSENGER CARS OR NEW LIGHT DUTY TRUCKS UNDER 2,000 LBS RATED CARRYING CAPACITY—(2 YEAR CERTIFICATE)	$21.75
OTHER GASOLINE POWERED VEHICLES	$12.50
EMISSIONS TEST ONLY	$27.00
VEHICLE REQUIRING F.M.C.S.R. ANNUAL INSPECTION	$50.00
TRAILERS (NOT REQUIRING F.M.C.S.R. INSPECTION)	$12.50
MOTORCYCLES	$12.50
MOPEDS	$5.75
IDENTIFICATION CERTIFICATE (VI-30/VI-30A)	$1.00

ADJUSTMENTS AND REPAIRS WILL BE IN ADDITION TO THE ABOVE FEES

Continue

TEXAS DEPARTMENT OF PUBLIC SAFETY
AIRCHECKTEXAS EMISSIONS PROGRAM

NOTICE TO MOTORISTS

INSPECTION FEES IN EL PASO COUNTY

Effective 5-1-2002

GASOLINE POWERED MOTOR VEHICLES 2-24 YEARS OLD	$39.50
NEW PASSENGER CARS OR NEW LIGHT DUTY TRUCKS UNDER 2,000 LBS RATED CARRYING CAPACITY—(2 YEAR CERTIFICATE)	$21.75
OTHER GASOLINE POWERED VEHICLES	$12.50
EMISSIONS TEST ONLY	$14.00
VEHICLE REQUIRING F.M.C.S.R. ANNUAL INSPECTION	$50.00
TRAILERS (NOT REQUIRING F.M.C.S.R. INSPECTION)	$12.50
MOTORCYCLES	$12.50
MOPEDS	$5.75
IDENTIFICATION CERTIFICATE (VI-30/VI-30A)	$1.00

ADJUSTMENTS AND REPAIRS WILL BE IN ADDITION TO THE ABOVE FEES

Continue

TEXAS DEPARTMENT OF PUBLIC SAFETY
AIRCHECKTEXAS EMISSIONS PROGRAM

NOTICE TO MOTORISTS

INSPECTION FEES IN TRAVIS AND WILLIAMSON COUNTIES

Effective 9-1-2005

GASOLINE POWERED MOTOR VEHICLES 2-24 YEARS OLD	$25.50
NEW PASSENGER CARS OR NEW LIGHT DUTY TRUCKS UNDER 2,000 LBS RATED CARRYING CAPACITY—(2 YEAR CERTIFICATE)	$21.75
OTHER GASOLINE POWERED VEHICLES	$12.50
EMISSIONS TEST ONLY	$18.00
VEHICLE REQUIRING F.M.C.S.R. ANNUAL INSPECTION	$60.00
TRAILERS (NOT REQUIRING F.M.C.S.R. INSPECTION)	$12.50
MOTORCYCLES	$12.50
MOPEDS	$5.75
IDENTIFICATION CERTIFICATE (VI-30/VI-30A)	$1.00

ADJUSTMENTS AND REPAIRS WILL BE IN ADDITION TO THE ABOVE FEES

Continue

EmissionsOverview

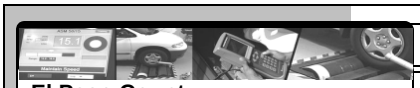
Dallas/Ft. Worth/Houston/Galveston Areas

Current Certificates

New Certificates

Continue

Texas Department of Public Safety



EmissionsOverview

El Paso County

Current Certificate

New Certificate

Continue

Texas Department of Public Safety

EmissionsOverview

Travis/Williamson Counties

Continue

Texas Department of Public Safety

ACCELERATION SIMULATION MODE (ASM) TEST INSPECTOR'S GUIDE

Texas Department of Public Safety

May 2005

Prepared by
dKC – de la Torre Klausmeier Consulting, Inc.

Under Contract with the
Texas Department of Public Safety

Texans - Doing our share for cleaner air!

PERFORMING ASM TESTS

ASM TESTING

WHAT IS THE ASM TEST?

Beginning in May 2002, most 1995 and older model vehicles in the Dallas and Houston Metropolitan areas will receive ASM (acceleration simulation mode) tests during their annual emissions and safety inspection.

The ASM test uses a dynamometer, or "rolling road," to simulate on-road driving conditions.

With the ASM test, HC, CO and oxides of nitrogen (NOx) emissions are measured during two modes: a high load / low speed (15 mph) condition (the 50/15 test) and a moderate load / moderate speed (25 mph) condition (the 25/25 test).

Only 1995 and older gasoline vehicles up to 25 years of age will be required to be ASM tested.

Texas Department of Public Safety

ASM TESTING

WHAT IS THE ASM TEST?

HC and NOx from motor vehicles are major constituents of Urban Smog.

The purpose of this course is to familiarize inspectors with the ASM test.

Texas Department of Public Safety

WHY IS TEXAS SWITCHING TO THE ASM TEST?

Compared to the current Two-Speed Idle (TSI) test, the ASM test identifies a more emission-related problems and it is more difficult to get a vehicle to pass it without performing necessary repairs.

With the TSI test emissions of NOx can not be evaluated, since a vehicle must be operated under load before NOx emissions can be accurately assessed.

The ASM test measures NOx along with HC and CO emissions. The inspection program is much more effective against smog when it measures NOx as well as HC.

WHY IS TEXAS SWITCHING TO THE ASM TEST?

The TSI test does not identify as many HC and CO problems as the ASM test.

Many problems do not show-up during idle and high idle conditions.

With the TSI test, technicians can mask problems that are identified during idle and high idle tests with temporary measures.

For example, inducing a vacuum leak can mask a rich engine condition.

ASM Test System Components

The primary new components of the ASM test system (termed ASM EIS) are the dynamometer and 5-gas exhaust analyzer.

The dynamometer, or "rolling road" is used to simulate on-road driving conditions.

The 5-gas analyzer measures NOx as well as HC and CO emission levels.

ASM EIS Dynamometer

Major Components of the ASM dynamometer :

- Drive rolls
- Platform lift
- Vehicle restraints
- Power absorption unit (PAU),

ROLLS and LIFT

Rolls: The dynamometer has two sets of rolls to support the vehicle's drive wheels.

You can test vehicles in either direction on the dynamometer.

Dynamometer Lift System: The ASM EIS uses a software-controlled lift system to allow vehicles to drive on and off the dynamometer.

Raising the lift, locks rolls in place, enabling the operator to drive the vehicle on and off the rolls.

Lowering the lift platform, unlocks the rolls, releasing them to spin freely during vehicle testing.

VEHICLE RESTRAINTS

The ASM EIS includes three types of vehicle restraints: ratcheting tie-down straps, wheel chocks, and lateral wheel restraints.

All vehicles must be restrained in *all* directions (side-to-side, as well as forward and backward).

Never operate an unrestrained vehicle on the dynamometer rolls! Vehicles normally move laterally (side-to-side) on the dynamometer. Front-wheel drive vehicles *must be* restrained from moving laterally on the dynamometer.

Power Absorption Unit (PAU)

The PAU has iron rotors and stationary field coils, which apply a vehicle-specific load to the dynamometer.

- The PAU cover houses high-voltage components.
- Use extreme caution when removing it from the dynamometer.

Do NOT block the PAU cover vents with paper, cloth, boxes, etc.

- Air must be able to pass through these openings.
- Be aware that the PAU cover becomes extremely hot during dynamometer operation. Use caution when near the PAU to avoid burns.

5-Gas Emissions Analyzer

The 5-gas emissions analyzer measures Hydrocarbons (HC), Carbon Monoxide (CO), Nitric Oxide (NO), Carbon Dioxide (CO_2), and Oxygen (O_2).

The emissions analyzer uses different technologies to detect and measure exhaust pollutants:

- Non-dispersive infrared technology measures HC, CO, and CO_2.
- A NO cell measures nitric oxide. The NO cell must be replaced periodically.
- An O_2 cell measures oxygen. The O_2 cell also requires periodic replacement.

General Safety Tips

The following safety tips must be followed to assure the safety of the inspector:

Inspect test vehicle tires for tears, blemishes, proper inflation and size uniformity before driving the vehicle onto the dynamometer.

- If necessary, make repairs or replacements before you begin testing.

Inspect test vehicle for fluid leaks before driving it onto the dynamometer.

Make repairs before you begin testing.

- NEVER make repairs to the vehicle's engine or engine compartment when the dynamometer is in use.

General Safety Tips

NEVER operate the dynamometer without first restraining the vehicle.
- Connect all restraints, placing wheel chocks in front and behind the non-drive wheels of the test vehicle.
- Make sure the floor is clean and dry to keep the wheel chocks firmly in place.

NEVER operate the vehicle in reverse on the dynamometer, except when removing the vehicle.

Always raise the lift before exiting the vehicle from the dynamometer.

The vehicle operator MUST remain in the driver's seat at all times during a drive cycle test.
- Do NOT attempt to get in or out of the vehicle while the dynamometer rolls are moving.

General Safety Tips

NEVER operate the dynamometer without its cover panels in place.
- Using a dynamometer with exposed cavities and operating components can be extremely hazardous.
- Clearly mark the test area and install protective guard railings, for your protection and that of your personnel.

NEVER allow personnel to stand on, or in contact with, the dynamometer when raising or lowering the lift.
- The lift can produce more than 6,000 lbs. of lifting force and several places exist where hands and feet could be trapped and crushed.

General Safety Tips

During dynamometer operation, personnel must maintain proper clearance.
- Allow at least four feet of clearance to the front, rear and sides of the dynamometer.
- Stay clear of the rolls, especially when the dynamometer is in use.

Beware of projectiles.
- Tires rotating at high rates of speed can throw off stones and other embedded objects.
- Wear approved safety glasses when in the vicinity of a vehicle under test.

General Safety Tips

NEVER slam on the vehicle brake when the wheels are in motion on the dynamometer.

- The vehicle's brakes can produce rates of deceleration equal to several hundred horsepower, capable of propelling the vehicle off the dynamometer rolls.
- A vehicle exiting the dynamometer in this manner may incur property damage and injury to personnel, snap the roll-to-roll drive coupling belt, and cause damage to internal dynamometer components.
- ASM systems have augmented braking functions that reduce roll speed at appropriate times.

General Safety Tips

With above ground installations, ALWAYS use extreme caution when driving on and off the ramps and platforms.

Always properly vent the exhaust gases during all emissions tests.

ASM TEST PROCEDURES

- Pre-inspection - Is vehicle safe for testing?
- Determine if the vehicle is front or rear wheel drive.
- Drive onto dynamometer
- Lower the lift
- Stabilize and restrain vehicle on dynamometer
- Precondition vehicle – 30 seconds
- 50/15 test – Maximum 90 Seconds, usually less than 30 seconds.
- 25/25 test – Maximum 90 Seconds, usually less than 30 seconds.

A complete safety inspection will be performed on the vehicle prior to the ASM.

Pre-Test Vehicle Inspection

To prevent vehicle damage, it is very important to conduct a thorough vehicle inspection before performing ASM testing. Problems with the vehicle can permanently damage the vehicle or the ASM EIS.

Before testing, make certain that the vehicle can be safely tested on the dynamometer.

- **NEVER** test Traction-Control or All-Wheel Drive vehicles on a single-axle, Two-Wheel Drive dynamometer.
  - *Viscous couplings on many modern All-Wheel Drive systems tend to overheat, and may incur permanent damage as a result.*

Pre-Test Vehicle Inspection

- Confirm both drive wheel tires are the same size.
- Adjust the tire pressure to the vehicle manufacturer's specification (or as shown on the tire sidewall) and inspect the tread for defects, bulges, or tire cord protrusions.
- Do *not* operate the vehicle on the dynamometer if a temporary spare tire ("space-saver") is installed on one of the vehicle's drive wheels (you shouldn't anyway), if tire cord is visible on any of the tires, or if there are any other tire defects.

Pre-Test Vehicle Inspection

Inspect the vehicle for fuel, coolant, and oil leaks.

Do *not* operate a vehicle on the dynamometer if it leaks fluid. Make sure vehicle fluid levels (oil, transmission, coolant, power steering, etc.) meet the vehicle manufacturer's requirements.

Inspect the vehicle for exhaust leaks. Repair any leaks before performing tests to prevent sample dilution errors and ensure accurate test results.

Enter Vehicle Parameters

Vehicle parameters are used to determine the Equivalent Test Weight (ETW) and pass/fail standards.

ETW is used to set the dynamometer loadings.

Pass/fail standards depend on age, vehicle type, and ETW.

Positioning Vehicle on the Dynamometer

Make certain the dynamometer lift plate is up. Raise the lift.
Clear obstructions away from the driving path to the dynamometer.

Remove the lateral wheel restraints if they are attached to the dynamometer. Driving the vehicle onto the dynamometer when the restraints are in place can damage the vehicle and the lateral wheel restraints.

Position the vehicle's drive wheels in front of and square with the dynamometer rolls. If necessary, ask an assistant to direct you

Slowly drive the vehicle's drive wheels into position on the dynamometer rolls.

Lower the lift.

Align and restrain the vehicle on the dynamometer rolls.

Restraining the Vehicle

The analyzer will provide the following screen prompt:

IS THE VEHICLE A FRONT-WHEEL DRIVE? (YES/NO)

Front-wheel drive vehicle: Laterally stabilize, restrain and chock. Apply parking brake.

REAR-WHEEL DRIVE VEHICLE: RESTRAIN AND CHOCK.

ALIGNING FRONT WHEEL DRIVE VEHICLES

Align the vehicle on the dynamometer rolls as follows:

A. Apply the brakes.

B. Shift the transmission to "Drive" for automatic transmissions or "First" for manual transmissions.

C. *Slowly* release the brake or clutch so the tires rotate very slowly. **Do not exceed 3 mph!**

D. Gently apply the brake once the vehicle settles and continue holding it.

E. Shift the transmission to "Park" for automatic transmissions or "Neutral" for manual transmissions.

ALIGNING FRONT WHEEL DRIVE VEHICLES

Apply the parking brake to restrain the non-drive wheels.

Apply external vehicle restraints.

Visually check the vehicle's alignment with the dynamometer rolls.

If the vehicle is not correctly aligned with the rolls, raise the dynamometer lift. Slowly drive the vehicle off the dynamometer and repeat above procedure

Positioning Cooling Fan

The analyzer will prompt the technician to turn on the fan and to place it in position if the ambient (outside) temperature is above 72 deg F.

Obtaining RPM Signal

The analyzer will provide the following screen prompt:

SELECT RPM PICK-UP DEVICE

1. CONTACT
2. NON-CONTACT
3. OBD II PORT
4. OTHER

UNSTABLE RPM SIGNAL – CHECK OR CHANGE PICK-UP

Probe Insertion Gear Selection

The analyzer will prompt the technician to insert the sample probe into the tailpipe.

The technician will be prompted, as appropriate, on transmission type:

1. Automatic Transmissions
   PLACE THE TRANSMISSION IN DRIVE. IF THE ENGINE RPM EXCEEDS _____, PLACE THE TRANSMISSION IN OVERDRIVE. (Value will be shown by test system)

2. Manual Transmissions
   PLACE THE TRANSMISSION IN SECOND GEAR.
   KEEP ENGINE RPM BETWEEN ____ AND ____RPM. (Value will be shown by test system)

Tire Drying

The analyzer will prompt the technician as follows:

DO THE TIRES NEED DRYING? (YES/NO)

If YES, the analyzer will require the technician to run the vehicle at any speed below 30 mph.

When the roll speed exceeds 1 mph, the screen will display the following delay message which will include the seconds that must be waited until the test mode can begin.

ONCE THE TIRES ARE DRY, YOU MUST WAIT AT IDLE FOR ____ SECONDS PRIOR TO BEGINNING THE PRECONDITIONING MODE. (Value will be shown by test system)

ASM-2 Pre Emissions Test Conditions

The following conditions must be met before the ASM EIS begins the test sequence:

a. Zero air, electronic span, ambient air, and hang up checks have been performed.
b. The ASM EIS does not detect a "low-flow" or diluted exhaust condition.
c. The engine idle speed is between 400 and 1250 RPM.
d. The dynamometer rolls are not turning (speed <1 mph). If the roll speed exceeds this limit, or the engine speed exceeds 1250 RPM, the following delay message will be displayed:

DELAY TESTING, YOU MUST WAIT ____ SECONDS.
(Value will be shown by test system)

Preconditioning procedures

The analyzer will display the following prompt:

PRECONDITIONING CAN BEGIN. ACCELERATE GRADUALLY TO 15 MPH
The inspector must maintain this speed for 30 seconds.

If, at any time during the preconditioning mode, the speed and RPM criteria or the gear selection criteria fall outside the acceptable ranges, the software will display one of the following appropriate messages to prompt the driver to correct the problem.

- OUTSIDE PRECONDITIONING SPEED LIMIT
- LOW FLOW / OUTSIDE DILUTION SPECIFICATION
- OUTSIDE ENGINE RPM RANGE
- DYNO LOADING ERROR

50/15 TEST

At the conclusion of the preconditioning mode the analyzer will prompt the driver to maintain the vehicle at 15 mph ± 01 mph.

The system will display the 50/15 test speed with applicable speed limits, test time, and engine RPM.

The vehicle will pass the ASM 50/15 mode and the mode will be immediately terminated if the 10 second running average measured values for each pollutant are less than or equal to the applicable test standards.

If test criteria fall outside acceptable ranges, the analyzer will display messages to prompt the driver to correct the problem.

- OUTSIDE TEST SPEED LIMIT
- OUTSIDE ENGINE RPM RANGE
- DYNO LOADING ERROR
- LOW FLOW / OUTSIDE DILUTION SPECIFICATION

25/25 TEST

At the conclusion of the 50/15 test, the inspector will be prompted to increase speed to 25 mph.

The 25/25 mode will begin when the roll speed (and corresponding power) is stabilized at 25 mph ± 01 mph for five consecutive seconds.

A vehicle will pass the 25/25 test mode if the 10-second average readings for HC, CO and NO are all equal to or below the applicable standards for the vehicle.

If test criteria fall outside acceptable ranges, the software will display messages to prompt the driver to correct the problem.

- OUTSIDE TEST SPEED LIMIT
- OUTSIDE ENGINE RPM RANGE
- DYNO LOADING ERROR
- LOW FLOW / OUTSIDE DILUTION SPECIFICATION

ASM TESTING

Restart Procedures

If the test parameters fall out of pre-determined limits, the system will prompt the inspector to restart
- TEST MODE MUST BE RESTARTED

Conditions Causing Test Mode Restart (either mode):
- Acceleration violation
- Dynamometer load outside of specification
- Sample dilution
- Analyzer "low flow" condition
- Vehicle speed outside test limit
- Engine speed outside of range

The maximum number of restarts is two, otherwise the test will be aborted.

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ASM TESTING

Second Chance Tests

If all emissions results (HC, CO, and NO) for both ASM Modes are within 150% of the applicable standards, the system will give the following prompt:
- SECOND CHANCE 50/15 TEST AUTHORIZED. PLEASE GRADUALLY DECELERATE TO 15 MPH AND REPEAT THE ASM 50/15 MODE.

If the vehicle fails the second-chance ASM50/15, then the vehicle will fail the test. Otherwise, the vehicle will also receive a second-chance ASM 25/25.
- SECOND CHANCE 25/25 TEST AUTHORIZED. PLEASE CONTINUE SPEED AT 25 MPH.

If the vehicle passes the second chance 25/25 mode and passed the first chance ASM 50/15 mode, the vehicle will pass the ASM-2 test.

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GAS CAP TEST

Every gasoline powered vehicle from 2-24 model years old will be checked to determine if the gas cap is missing or defective.

- Conduct daily calibration check of gas cap testing device.
- Check for presence.
- Check for correct type of gas cap(s).
- Remove gas cap(s) and test using an approved testing device.
- Any gas cap(s) failing the initial test will be tested second time to verify failure.

GAS CAP TEST

EXEMPTIONS

Slow-moving vehicles.

A motor vehicle designed to operate at a maximum speed of 25 miles per hour.

Motorcycles.

Vehicles operated exclusively by a fuel other than gasoline.

Vehicles newer than 2 years old and older than 24 years old.

End of ASM-2 Emissions Test Mode

At the completion or termination of the ASM two-mode inspection, the analyzer will display the following message:

END OF ASM-2 EMISSIONS TEST

REMOVE RESTRAINING SYSTEM FROM VEHICLE.

REMOVE COOLING FAN, TACHOMETER LEAD AND SAMPLE PROBE.

[redacted]

ASM System Calibration

Periodically, the ASM system must be calibrated, or the inspector will be locked out from further testing.

The system will guide the inspector through the following:

- Gas calibration (Required every 72 hours)
- Leak check (Required every 24 hours)
- Gas cap calibration (Required every 24 hours)
- Dynamometer Calibration (Required every 72 hours)

Maintenance Safety Tips

Electrical Shock Hazard.
Turn off electrical service to the system before performing any maintenance activity. Turn off the main breaker in the breaker box before working on anything related to the PAU.

No Jewelry.
Before performing any electrical or mechanical troubleshooting, repair, etc. on the dynamometer, remove all jewelry.

Dynamometer Cover Panels.
When performing maintenance on the dynamometer, use extreme caution near drive mechanisms and moving parts -- especially after removing any of the cover panels.

Avoid Straining Yourself.
Be careful when lifting the PAU cover; it is large and heavy. Be very careful when replacing belts, couplings, or bearings -- the rolls are very heavy and can be difficult to handle.

ASM TESTING

Maintenance Safety Tips

Watch Your Hands
Never put your hand between the lift beam and roll with the air connected to the system. The lift could release, trapping and crushing hands and fingers.

Air Pressure.
Make sure no air pressure is in the lines when working near the lift, brakes or air bellows.

NEVER, NEVER, NEVER pull on the drive belt in order to spin the rolls! Failure to release the belt may trap fingers between the pulleys and drive belt. The force is strong enough to sever fingers from the hand.

Water Accumulation.
Do not allow water accumulation in the dynamometer pit!

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DISCLAIMER

Always refer to the manufacturers' operating manual and help desk for assistance.

On-Board Diagnostics II (OBD II)
INSPECTOR'S GUIDE

Texas Department of Public Safety

May 2005

Prepared by
dKC – de la Torre Klausmeier Consulting, Inc.

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INSPECTING ONBOARD DIAGNOSTIC (OBDII) SYSTEMS

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OBDII TESTING

INTRODUCTION

On-board diagnostic systems (OBD) on 1996 and newer vehicles will be checked as part of Texas' vehicle inspection program.

The purpose of this course is to familiarize vehicle inspectors with OBDII systems and what it means when a vehicle fails the OBDII inspection.

This course addresses:

Air quality in Texas – Why are we concerned about vehicle pollution?

The Texas OBDII Inspection Procedure

OBDII TESTING

AIR QUALITY

Why are we concerned about motor vehicle pollution?

Motor vehicles emit toxic air pollutants and contribute to the formation of ground level ozone. A 'typical' vehicle emits a half ton of air pollution annually. A malfunctioning vehicle emits many times that amount.

OZONE

Texas has a serious ozone pollution problem.

Motor vehicle related smog (ground-level ozone) damages lung tissue and aggravates respiratory disease.

Ozone is formed by atmospheric reactions between hydrocarbons (HC) and oxides of nitrogen (NOx).

Motor vehicles are the largest source of ground-level ozone (smog) in Texas.

OZONE

Other air quality problems due to motor vehicles

Toxic compounds threaten human health even at very low levels. Motor vehicles are the largest source of toxic/carcinogenic air pollutants in Texas.

Carbon monoxide (CO) is a toxic air pollutant that impairs cardiovascular function. Motor vehicles are the largest source of CO in Texas.

The primary purpose of OBDII is to insure that vehicles emit the minimum amount of pollutants through their useful life.

OBDII INSPECTION

OBDII systems monitor all components that affect vehicle emissions. OBDII systems detect and record malfunctions of these components, often before the motorist becomes aware of any problem.

The OBDII inspection consists of checking the results of the self-tests that have occurred while the vehicle was driven prior to the time of inspection.

The vehicle does not have to be warmed-up to perform an OBDII inspection, unlike a tailpipe test.

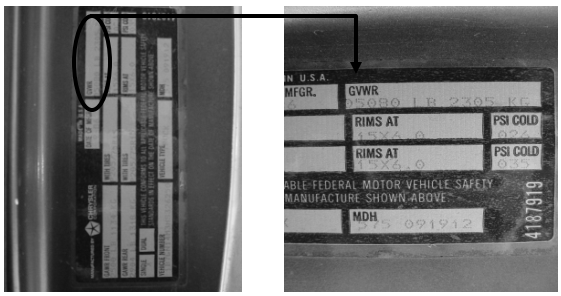
Step 1. Determine Applicability

OBDII systems were required on all model year 1996 or newer gasoline powered vehicles with a GVWR (gross vehicle weight rating) of 8,500 pounds or less.

Vehicles with a GVWR of 8,501 and greater are not required to have a Diagnostic Link Connector (DLC).

The inspector must enter all required information as accurately and correctly as reasonably possible. Incorrect information may cause inaccurate test results.

GVWR Plate



Step 2. Connect Inspection System

All 1996 and newer vehicles with a GVWR of 8,500 and less are equipped with a standardized Diagnostic Link Connector (DLC). This is to allow a generic inspection tool to be used on all OBDII equipped systems.

With the ignition key off, locate the vehicle's Diagnostic Link Connector (DLC) and plug the OBDII test lead into the DLC.

DLC Location

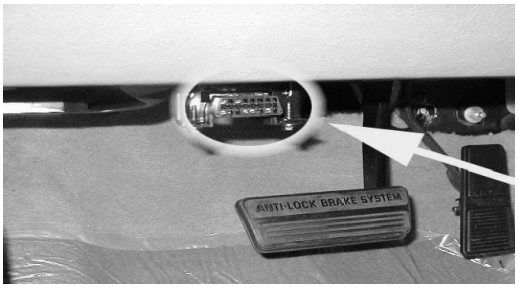
The diagnostic connector is required to be located between the driver's end of the instrument panel and approximately one-foot beyond the vehicle centerline, on or below the instrument panel.

On most vehicles, the connector is located beneath the instrument panel, near the steering column. And the connector is usually exposed.

Some vehicles have hard to find DLC connectors.

Use care when removing covers over any DLC.

Typical DLC Location



Not So Typical DLC Location

Hidden Behind Cover

Hidden Behind Two Covers

Hidden Behind Wood Cover

Inspection Tool Connected to DLC

Step 3. Visual Inspection of Malfunction Indicator Light (MIL)

The Malfunction Indicator Light (MIL) is the official term for the warning light (amber in color) that is illuminated by the vehicle's OBD system when a malfunction occurs.

Depending on the vehicle make, the MIL will either display "Service Engine Soon," "Check Engine," the international engine symbol along with the word "Check," or some combination of these.

The purpose of the MIL is to alert the driver to the malfunction so repairs can be performed in a timely manner.

MIL Symbols

Types of MIL Illumination

When severe misfire occurs that could damage the catalytic converter, the MIL is required to flash on and off once per second. Flashing is intended to discourage vehicle operation.

Constant illumination of the MIL (i.e., it is not flashing) indicates that a problem has been detected and the vehicle should be serviced as soon as possible.

Visual Inspection of the MIL

The inspector performs two checks of the MIL:

Key-On Engine Off (KOEO)

Key-On Engine Running (KOER)

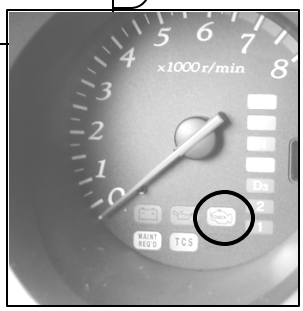
WARNING: Failure to answer either question properly could result in a 6 month suspension of your inspector license.

Step 3a. Visual Inspection of the MIL -- Key On, Engine Off (KOEO)

KOEO

Determine if the instrument panel MIL illuminates when the ignition key is turned to the "key on, engine off" (KOEO) position.

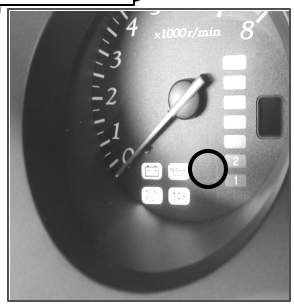
The MIL must come on when the ignition key is turned to the "key on, engine off" position. This is to allow technicians to check that the MIL is capable of illuminating if a malfunction were to occur.



Step 3a. Visual Inspection of the MIL -- Key On, Engine Off (KOEO)

KOEO

On most vehicles, the MIL will stay illuminated as long as the key is in the "key on, engine off" position. However, on some vehicles, e.g., Chryslers and Hondas, the MIL will illuminate very briefly when the key is turned to the "key on, engine off" position and then will go out. This is acceptable.



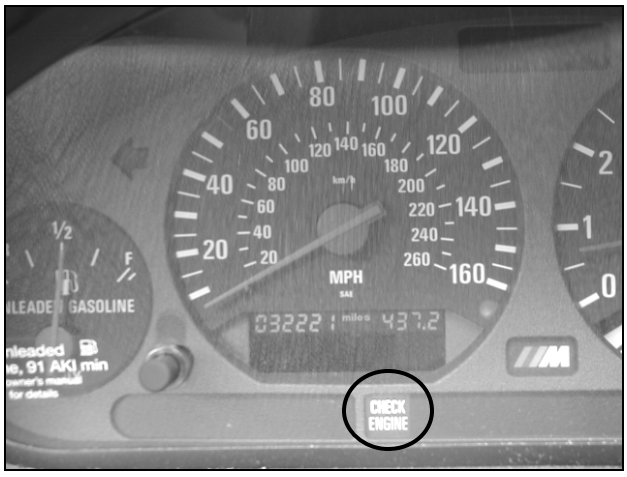
Step 3b. Visual Inspection of the MIL -- Key On, Engine Running (KOER)

KOER

Start the engine and allow it to idle. Determine if the MIL is illuminated while the engine is running.

If the MIL is on while the engine is running, the vehicle's OBD system has determined that there is a problem with the vehicle. In this case, there should be one or more diagnostic trouble codes (DTCs) stored in the vehicle's computer.

If the MIL is not illuminated, the analyzer does not consider any DTC's, i.e. Pending or History codes.



Be sure to look at the correct light.

The MIL will say "Service Engine Soon," "Check Engine," or the international engine symbol.

Maintenance reminder lights are not MILs.

DO NOT FAIL a vehicle if the maintenance reminder light is on.

Step 4. OBDII System Download

After the KOER test, press continue to download data from the OBDII system. Test system will communicate with on-board computer. If communication cannot be established, system will prompt inspector to recheck connection and try again. After communication is made, test system automatically does the following:

Downloads readiness status

Downloads MIL status

Diagnostic trouble codes (DTCs)

READINESS

OBDII systems must indicate whether or not the onboard diagnostic system has monitored each component.

Components that have been diagnosed are termed "ready", meaning they were tested by the OBDII system.

Once a monitor has been set to "ready", it will continue to indicate "ready" unless the vehicle's battery is disconnected or codes are cleared, with a few exceptions.

READINESS

Normally, the readiness status of all components or systems will be “ready”.

However, some technicians will disconnect the battery or clear codes with a scan tool to turn off the MIL. If the vehicle’s battery has been recently disconnected, or if DTCs have been recently cleared with a scan tool, all non-continuous components or systems will be set to “not ready”.

How Monitors Become Ready

The powertrain control module (PCM-OBDII terminology for the onboard computer) sets a monitor to “ready” after an appropriate drive cycle has been performed.

Normal driving MAY set a monitor to ready in a couple of days.

The dealer or qualified technician has the best information on drive cycles and how to get a vehicle ready.

MIL Status

MIL status refers to whether or not the PCM has commanded the MIL to be on.

The purpose of checking MIL status using the inspection system is to determine if the vehicle’s OBD system has commanded the MIL to turn on based on a malfunction. This allows you to determine if there is a malfunction, even if the MIL is not actually illuminated, The MIL may not be on because of a problem with the MIL itself, or due to tampering with the MIL.

DIAGNOSTIC TROUBLE CODES (DTCs)

If the MIL is commanded-on, the system will download diagnostic trouble codes (DTCs.) DTCs describe the specific problem identified by the OBDII system.

Under the OBDII requirements, all manufacturers must comply with a standardized convention for DTCs.

The universal DTC format consists of a 5-character alphanumeric code, consisting of a single letter character followed by four numbers. i.e. (P0301)

Whenever the MIL is illuminated a DTC should be stored in the PCM.

INSPECTION PASS/FAIL CRITERIA

1) The MIL does not illuminate at all when the ignition key is turned to the "key on, engine off" (KOEO) position.

This test determines if the MIL is working. The OBDII system cannot alert drivers to problems if the MIL does not work.

PASS/FAIL CRITERIA

2) The MIL is illuminated when the engine is running --"key on, engine running" (KOER)

The reason this is a failure is because the vehicle's OBDII system has detected a malfunction and turned on the MIL to alert the driver. If the MIL is on while the engine is running, the vehicle's OBDII system has determined that there is a problem with the vehicle. In this case, there should be one or more diagnostic trouble codes (DTCs) stored in the vehicle's computer.

PASS/FAIL CRITERIA

3) The MIL status, as indicated by the scan tool, is ON.

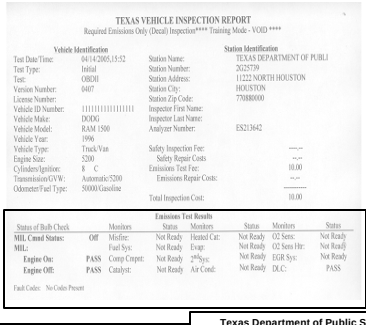
The purpose of checking MIL status using the inspection system is to determine if the vehicle's OBDII system has commanded the MIL to turn on based on a malfunction.

In most cases, the MIL should also be illuminated when the engine is running. However, even if the MIL is not illuminated with the engine running, the vehicle still fails because the inspection system shows that the vehicle's OBDII system tried to turn the MIL on as a result of a malfunction.

PASS/FAIL CRITERIA

4) More than the allowable numbers of monitors (2) are not ready.

Normally, the readiness status of all components or systems will be "ready". However, if the vehicle's battery has been recently disconnected, or if DTCs have been recently cleared with a scan tool, components or systems will be set to "not ready". This may have been done to temporarily extinguish the MIL for the inspection.



TEXAS VEHICLE INSPECTION REPORT

Required Emissions Only (Decal) Inspection**** Training Mode - VOID ****

Vehicle Identification			Station Identification	
Test Date/Time:	04/14/2005,15:52	Station Name:		TEXAS DEPARTMENT OF PUBLI
Test Type:	Initial	Station Number:	2025770	
Test:	OBDII	Station Address:	11222 NORTH HOUSTON	
Version Number:	0407	Station City:	HOUSTON	
License Number:		Station Zip Code:	770880000	
Vehicle ID Number:	1111111111111111	Inspector First Name:		
Vehicle Make:	DODG	Inspector Last Name:		
Vehicle Model:	RAM 1500	Analyzer Number:	ES213642	
Vehicle Year:	1996			
Vehicle Type:	Truck/Van	Safety Inspection Fee:		----.--
Engine Size:	5200	Safety Repair Costs		----.--
Cylinders/Ignition:	8 C	Emissions Test Fee:		10.00
Transmission/GVW:	Automatic/5200	Emissions Repair Costs:		----.--
Odometer/Fuel Type:	50000/Gasoline			----------
		Total Inspection Cost:		10.00

Emissions Test Results

Status of Bulb Check		Monitors	Status	Monitors	Status	Monitors	Status
MIL Cmnd Status:	Off	Misfire:	Not Ready	Heated Cat:	Not Ready	O2 Sens:	Not Ready
MIL:		Fuel Sys:	Not Ready	Evap:	Not Ready	O2 Sens Htr:	Not Ready
Engine On:	PASS	Comp Cmpnt:	Not Ready	2ndAir Sys:	Not Ready	EGR Sys:	Not Ready
Engine Off:	PASS	Catalyst:	Not Ready	Air Cond:	Not Ready	DLC:	PASS

Fault Codes: No Codes Present

PASS/FAIL CRITERIA

5) DLC missing or damaged / communication failure:

This is a failure because you are not able to access Information stored in the vehicle's OBDII system.

Non-Communication

Vehicles under 8,501 GVWR Non-Communication

If the vehicles' computer fails to communicate with the analyzer, the analyzer will prompt the inspector as to **WHY**.

Choose the appropriate response:

Connector cannot be located.

Connector is missing, damaged or tampered.

Connector is obstructed or inaccessible.

Communication failed and OBD port is attached.

Non-Communication

Communication failed and OBD port is attached

If the above option is chosen, and you have a full service analyzer, the analyzer will default to the appropriate tailpipe test.

If the above option is chosen, and you have an **OBD ONLY** analyzer, the analyzer will abort the test and the **vehicle will be referred to a full service station.**

Non-Communication

Vehicles over 8,500 GVWR Non-Communication

Vehicles with a GVWR over 8,500 are not required to have a DLC.

After entering the correct GVWR into the analyzer, select "No Connector" **(if connector is not present)** and complete the Heavy Duty Inspection Sequence.

Problematic Vehicles

Certain vehicle Readiness Monitors will never remain "Ready" after turning the key to the off position. Refer to the following bulletin for inspection procedures.

Dallas/Ft. Worth and Houston/Galveston Areas

Travis and Williamson Counties

NOTICE

(EFFECTIVE IMMEDIATELY)

CERTIFIED EMISSIONS INSPECTION STATIONS

(DALLAS/FT. WORTH AND HOUSTON/GALVESTON AREAS ONLY)

Certain vehicles experience significant difficulties undergoing the On-Board Diagnostic (OBDII) emissions test due to more than two monitors set to "Not Ready":

1996 & 1997 Mitsubishi; 1996 & 1997 Hyundai; 1996, 1997 & 1998 Volvo; 1996 Subaru; 1996 Kia; and 1996 & 1997 Eagle

OBDII-Only Inspection Stations may attempt testing the vehicles listed or may refer vehicles to an ASM/OBD (full service) station. However, if the vehicle fails only for more than two monitors set to "Not Ready", then the inspector shall abort the test, advise the vehicle owner there is NO CHARGE, and direct them to an ASM/OBD (full service) station.

ASM/OBD (full service) Inspection Stations shall attempt testing using standard OBDII procedures. However, if the vehicle fails only for more than two monitors set to "Not Ready", then the vehicle will receive the Acceleration Simulation Mode 2 (ASM2) tailpipe test, or a Two-Speed Idle (TSI) test if a full-time four wheel or all-wheel drive vehicle. To minimize difficulties for both inspection stations and vehicle owners, the Department directs the following:

For vehicles listed above:

- **ASM/OBD (full service) Inspection Stations** will attempt the OBDII test. The vehicle will fail OBDII test if:
  - ✓ MIL is commanded on and a Diagnostic Trouble Code (DTC) is stored in OBDII system, or
  - ✓ Vehicle fails bulb check (KOEO, KOER)
  - ✓ If the above conditions are NOT present, but the vehicle has more than two monitors set to "Not Ready", then it must transition to the Acceleration Simulation Mode 2 (ASM2) test or the Two-Speed Idle (TSI) test for full-time four wheel or all-wheel drive vehicles.

For 1996 and newer vehicles that are not listed above:

- **ASM/OBD & OBD-Only stations** – Vehicle will pass or fail based on standard OBDII testing procedure.

NOTE: 1. This notice supersedes notice dated May 10, 2002.
2. If the DLC (Diagnostic Link Connector) is obstructed and/or tampering is readily apparent on 1996 and newer vehicles, it must fail - Do not use ASM2 tailpipe test.

VIE-24 (Rev 04/05)

NOTICE

CERTIFIED EMISSIONS INSPECTION STATIONS

(TRAVIS AND WILLIAMSON COUNTIES ONLY)
Effective 9-1-2005

Certain vehicles experience significant difficulties undergoing the On-Board Diagnostic (OBDII) emissions test due to more than two monitors set to "Not Ready":

1996 & 1997 Mitsubishi; 1996 & 1997 Hyundai; 1996, 1997 & 1998 Volvo; 1996 Subaru; 1996 Kia; and 1996 & 1997 Eagle

OBD/TSI Inspection Stations shall attempt testing using standard OBDII procedures. However, if the vehicle fails only for more than two monitors set to "Not Ready", then the vehicle will receive a Two-Speed Idle (TSI) tailpipe test. To minimize difficulties for both inspection stations and vehicle owners, the Department directs the following:

For vehicles listed above:

- **OBD/TSI Inspection Stations** will attempt the OBDII test. The vehicle will fail OBDII test if:
  - ✓ MIL is commanded on and a Diagnostic Trouble Code (DTC) is stored in OBDII system, or
  - ✓ Vehicle fails bulb check (KOEO, KOER)
  - ✓ If the above conditions are NOT present, but the vehicle has more than two monitors set to "Not Ready", then it must transition to the Two-Speed Idle (TSI) tailpipe test.

For 1996 and newer vehicles that are not listed above:

- **OBD/TSI Inspection Stations** – Vehicle will pass or fail based on standard OBDII testing procedure.

NOTE: If the DLC (Diagnostic Link Connector) is obstructed and/or tampering is readily apparent on 1996 and newer vehicles, it must fail - Do not use Two-Speed Idle (TSI) tailpipe test.

VIE-24B (Rev 1/05)

OBDII TESTING

GAS CAP TEST

Every gasoline powered vehicle from 2-24 model years old will be checked to determine if the gas cap is missing or defective.

- Conduct daily calibration check of gas cap testing device.
- Check for presence.
- Check for correct type of gas cap(s).
- Remove gas cap(s) and test using an approved testing device.
- Any gas cap(s) failing the initial test will be tested second time to verify failure.

Texas Department of Public Safety

OBDII TESTING

GAS CAP TEST

EXEMPTIONS

Slow-moving vehicles.
A motor vehicle designed to operate at a maximum speed of 25 miles per hour.

Motorcycles.

Vehicles operated exclusively by a fuel other than gasoline.

Vehicles newer than 2 years old and older than 24 years old.

Texas Department of Public Safety

VEHICLE TEST REPORT

Customer receives a **vehicle test report** that includes the following information:

- The MIL illumination check results,
- If MIL is illuminated, DTC numbers and explanations,
- Readiness results,
- Alert statement based on reason for failing OBD.

DISCLAIMER

Always refer to the manufacturers' operating manual and help desk for assistance.

Back to Training Menu

Two-Speed Idle (TSI)
INSPECTOR'S GUIDE

Texas Department of Public Safety

May 2005

Prepared by
Texas Department of Public Safety

Texans - Doing our share for cleaner air!

AirCheckTexas

PERFORMING TSI TESTS

AirCheckTexas

TSI TESTING

WHAT IS THE TWO-SPEED IDLE (TSI) TEST ?

The TSI analyzer meets BAR' 96 two-speed idle specifications and tests vehicles for carbon dioxide in addition to hydrocarbons and carbon monoxide.

This test is required on model years 1995 and older, to and including 24 years old.

AirCheckTexas

TSI TESTING

WHAT IS THE TWO-SPEED IDLE (TSI) TEST ?

The TSI test comprises two phases:

(1) high speed test (2200 – 2800 RPMs)

(2) tested at idle (350 – 1200 RPMs)

The TSI test is followed by a gas cap integrity test that meets EPA – required specifications and procedures.

WHY THE TSI EMISSIONS TEST?

The TSI test will measure Hydrocarbon (HC), Carbon Monoxide (CO), and Carbon Dioxide (CO_2) in order to help reduce air pollution and identify emissions-related problems.

TSI Test System Components

The primary new components of the TSI test system is the 4gas exhaust analyzer and the attached gas cap tester.

The 4-gas analyzer measures HC, CO, CO2 and O2 emission levels.

4-Gas Emissions Analyzer

The emissions analyzer uses different technologies to detect and measure exhaust pollutants:

- Non-dispersive infrared technology measures HC, CO, and CO_2.
- An O_2 cell measures oxygen. The O_2 cell also requires periodic replacement.

Note: Always properly vent the exhaust gases during all emissions tests.

TSI TEST PROCEDURES

The inspector must enter all required information as accurately and correctly as reasonably possible. Incorrect information may cause inaccurate test results.

Pre-inspection - Is vehicle safe for testing?

Determine if the vehicle has a ZF-4 transmission. See Rules and Regulations Manual (Refer to the Emissions Manual reference section).

NOTICE

CERTIFIED EMISSIONS INSPECTION STATIONS
(EL PASO, TRAVIS, AND WILLIAMSON COUNTIES ONLY)
TSI TEST SEQUENCE - BMW/PEUGEOT/VOLVO/JAGUAR
(ZF AUTOMATIC TRANSMISSIONS)

Given the problems with the "ZF" automatic transmission, DPS prefers that the affected vehicles be tested at their dealerships. Accordingly, if the inspector enters an "A" (for automatic) for the transmission type, and if the vehicle type and the vehicle make, model, and model year match BMW/PEUGEOT/VOLVO/JAGUAR criteria, the TX 96 (TSI) analyzer displays the following message:

BECAUSE OF THE POSSIBILITY OF TRANSMISSION DAMAGE TO THIS VEHICLE, DPS PREFERS THAT IT BE INSPECTED AT ITS DEALERSHIP. IF YOU STILL WISH TO PERFORM THE INSPECTION, YOU MAY DO SO AT YOUR OWN RISK. PRESS "ENTER" TO CONTINUE. IF NOT, PRESS "ESC" TO ABORT THE TEST. (ENTER ABORT CODE 6)

If the inspector chooses to continue testing this vehicle, the following message will be displayed when beginning the test sequence:

BEFORE BEGINNING THE EMISSIONS TEST, MAKE SURE THE ENGINE IS AT NORMAL OPERATING TEMPERATURE. IF NOT, THE VEHICLE SHOULD BE DRIVEN UNTIL IT IS. DO NOT WARM THE ENGINE BY RAISING THE RPM ABOVE IDLE WHILE THE TRANSMISSION IS IN PARK OR NUETRAL.

AFTER THE ENGINE REACHES NORMAL OPERATING TEMPERATURE, PUT THE TRANSMISSION IN PARK AND TURN THE ENGINE OFF FOR 30 SECONDS. RESTART THE ENGINE. AFTER THE ENGINE IS RUNNING, DO NOT MOVE THE GEAR SHIFT SELECTOR THROUGH THE FORWARD OR REVERSE GEARS BEFORE OR DURING THE TEST SEQUENCE. DO NOT EXCEED 2000 RPM.

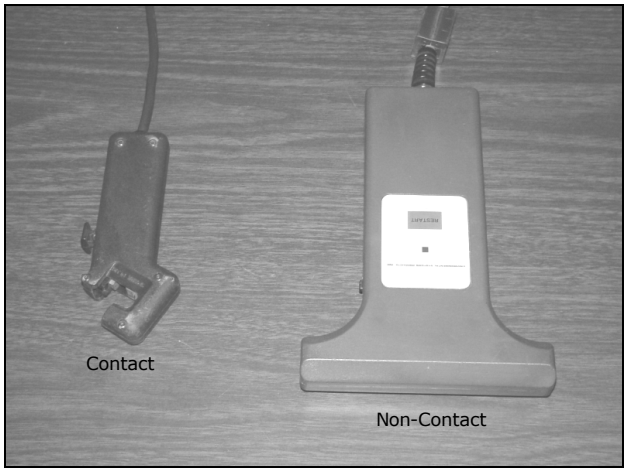
All 1984-87 BMWs with automatic transmissions, 1983-88 Volvo 740s with automatic transmissions, 1984-89 Jaguar XJSs, and 1986-92 Peugeot 505s with automatic transmissions shall be tested using this test sequence or the latest test sequence supplied by DPS.

CONTACT YOUR LOCAL DEPARTMENT OF PUBLIC SAFETY VEHICLE INSPECTION OFFICE IF YOU HAVE FURTHER QUESTIONS REGARDING ZF AUTOMATIC TRANSMISSIONS.

VIE-30 (5/04)

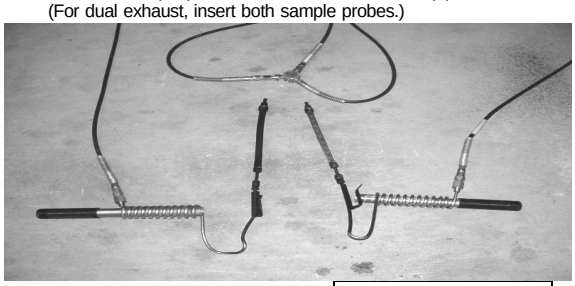
TSI TEST PROCEDURES

- Apply the parking brake and place the vehicle's transmission in neutral or park.
- Chock wheels
- Warm up engine
- Turn off accessories
- Attach RPM pick-up device
  - RPM Signal must be obtained through either the contact or non-contact pickup device
  - (UNSTABLE RPM SIGNAL – CHECK OR CHANGE PICK-UP)



TSI TEST PROCEDURES

Insert the sample probe into the vehicle's exhaust pipe.
(For dual exhaust, insert both sample probes.)



TSI TEST PROCEDURES

TURN ENGINE ON

INITIAL TEST

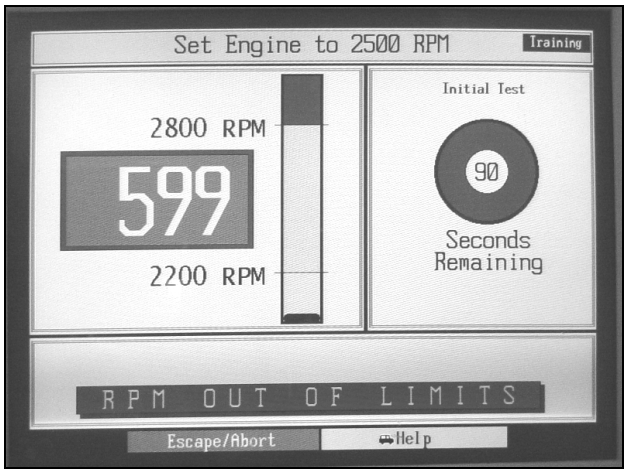
2200 – 2800 RPM test - Maximum 90 Seconds

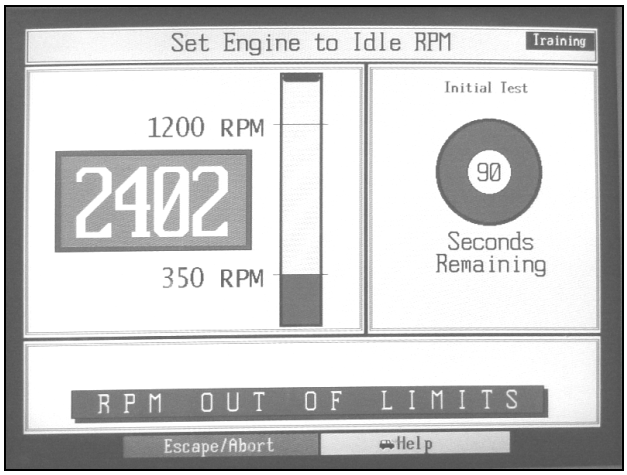
SECONDARY TEST

350 – 1200 RPM - Maximum 90 Seconds

Should the vehicle fail either Initial or Secondary test, the analyzer will default to a second chance test for only the mode that failed.

2200 – 2800 RPM test - Maximum 180 Seconds
350 – 1200 RPM - Maximum 90 Seconds





TSI TEST PROCEDURES

Next Slide

Reset Testing Procedures

Conditions Causing Test Mode to Reset:

- Sample dilution
- Analyzer "low flow" condition
- Engine speed outside of range

The system will reset and require the inspector to repeat the test:

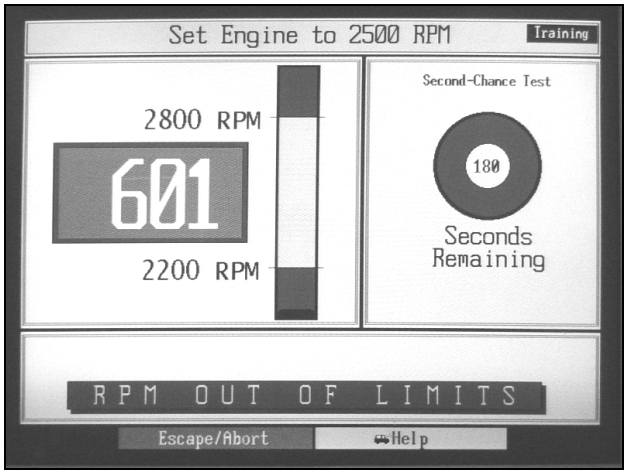
- The system timing clock will reset to zero if the engine RPM falls outside the approved range.
- If a sample dilution or low flow is detected, the analyzer will prompt the inspector to check the probe for proper insertion, visually reinspect the analyzer hoses and check the vehicle's exhaust system for leaks. Once a valid testing condition is achieved, the analyzer will reset the timing clock and resume testing.

Second Chance Tests

Should the vehicle fail either Initial or Secondary test, the analyzer will default to a second chance test for only the mode that failed.

2200 – 2800 RPM test - Maximum 180 Seconds

350 – 1200 RPM - Maximum 90 Seconds



AirCheckTexas

TSI TESTING

GAS CAP TEST

Every gasoline powered vehicle from 2-24 model years old will be checked to determine if the gas cap is missing or defective.

Inspection Procedure

- Conduct daily calibration check of gas cap testing device.
- Check for presence.
- Check for correct type of gas cap(s).
- Remove gas cap(s) and test using an approved testing device.
- Any gas cap(s) failing the initial test will be tested a second time to verify failure.

Texas Department of Public Safety

AirCheckTexas

TSI TESTING

GAS CAP TEST

EXEMPTIONS

Slow-moving vehicles.

A motor vehicle designed to operate at a maximum speed of 25 miles per hour.

Motorcycles.

Vehicles operated exclusively by a fuel other than gasoline.

Vehicles newer than 2 years old and older than 24 years old.

Texas Department of Public Safety

End of TSI Emissions Test Mode

At the completion or termination of the TSI inspection, the analyzer will display the following message:

END OF TSI EMISSIONS TEST

REMOVE TACHOMETER LEAD AND SAMPLE PROBE.

TSI System Calibration

Periodically, the TSI system must be calibrated, or the inspector will be locked out from further testing.

The system will guide the inspector through the following:

- Gas calibration (required every 72 hours)
- Leak check (required every 24 hours)
- Gas cap calibration (required every 24 hours)

NOTE: If the analyzer fails the gas cap calibration test, no inspection may be performed until the problem is repaired.

Texans - Doing our share for cleaner air!

DISCLAIMER

Always refer to the manufacturers' operating manual and help desk for assistance.

Back to Training Menu